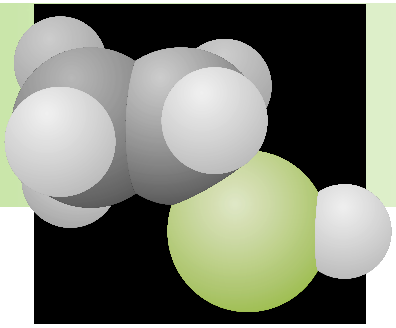
CHEMICALS

Project Fact Sheet



MEMBRANE REACTOR FOR THE PRODUCTION OF OLEFINS

BENEFITS

- Estimated energy savings of 5 trillion Btu per year, based on 10 billion pounds per year of capacity
- Increases productivity
- Reduces production cost by 4 cents per pound for propylene

APPLICATIONS

This process is useful in several applications. Dehydrogenation of propane is probably the most commercially important. The separation of propane from propylene by distillation to give polymer-grade propylene is an expensive and energy intensive operation. The use of membranes to accomplish this separation could be expected to make a significant reduction in both capital and operating costs.

A NOVEL MEMBRANE AND REACTOR COMBINATION INCREASES CONVERSION RATES

The petrochemical industry relies on light olefins as a principal feedstock. About 10 billion pounds per year of olefins such as propylene, butene and butadiene are produced by high temperature catalytic dehydrogenation of paraffin. The dehydrogenation reaction is equilibrium limited, with typically less than a 45 percent conversion rate. The low conversion necessitates a large separation step to recover product and recycle the large volume of unreacted paraffin. The project team will design and field-demonstrate a membrane reactor system that effectively increases the conversion rate, and reduces the energy requirement and size of the downstream distillation step.

Using a membrane reactor system to improve the conversion of dehydrogenation reactions could greatly reduce the cost of olefin separation and paraffin recycling. Traditionally, membrane reactor systems have had little commercial success due to a lack of suitable membrane materials and module supports. The new membrane reactor system design incorporates a high temperature membrane that preferentially permeates the conversion-limiting olefin products and hydrogen, but retains the unreacted paraffin. The unreacted paraffin is recycled to the reactor. Some unreacted paraffin permeates the membrane, but the amount is quite small, so separation of the permeate stream is much simpler and less costly than the conventional technology.

Membrane Pilot System

Pilot-scale membrane reactor systemused to improve the conversion of dehydrogenation reactions.

Project Description

Goal: The objective of this project is to develop an improved paraffin dehydrogenation process. This new process uses an olefin/hydrogen-permeable membrane to effectively shift the process equilibrium and to reduce the size of the final distillation step. The proposed reactor-membrane is expected to lower paraffin dehydrogenation process costs significantly.

Progress and Milestones

Significant progress has been made in the following areas:

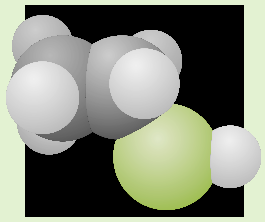
- Developed hydrogen-permeable membranes that operate at high temperatures
- Set targets for membrane development using a computer process simulator

Future research will focus on achieving the following milestones:

- Construct membranes and modules
- Evaluate membrane and module performance in the laboratory
- Build a module test system
- Conduct field demonstration
- Perform technical and economic analysis

Commercialization

Membrane Technology and Research, Inc. (MTR) envisions commercialization of the process in collaboration with one of the four major olefin process licensors. MTR has already achieved successful commercialization of three membrane technologies in markets similar to those of the reactor-membrane system. The VaporSep® system is the most developed of these technologies. More than 50 commercial units have been installed mainly in chemical and petrochemical plants. The VaporSep® system treats ethylene and propylene containing nitrogen purge gas streams from polyolefin plants.



Project Partners

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